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Inventor	:	**POIRIER, Bertrand**
Serial No.	:	**concurrently herewith**
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Title	:	**Proportional Control System for a Motor**

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February 15, 2005

Commissioner For Patents
PO Box 1450
Alexandria, VA 22313-1450

PRIORITY CLAIM

S I R:

This application is the National Stage of International Application No. **PCT/CA2003/001221**, filed **August 18, 2003**, which claims the benefit under 35 U.S.C. 119 (a-d) of **Canadian Patent Application 2,399,160** filed **August 16, 2002, which is herein incorporated by reference**.

Respectfully submitted,

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Canadian Patent Office

Certification

This is to certify that the documents attached hereto and identified below are true copies of the documents on file in the Patent Office.

Specification and Drawings, as originally filed, with Application for Patent Serial No:**2,399,160**, on August 16, 2002, by **IMPERIAL SHEET METAL LTD..**, assignee of Bertrand Poirier, for "Proportional Control System for a Motor".

PRIORITY DOCUMENT

SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

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Agent certificateur/Certifying Officer

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PROPORTIONAL CONTROL SYSTEM FOR A MOTOR

ABSTRACT

The present invention provides a proportional control system for use in a ventilation system comprising a central processing unit, programmed with a air exchange – defrost cycle operatively connected to a temperature sensor located in the air intake area of an HVAC unit and one or more motors located in the stale air intake of an HVAC unit wherein the temperature sensors determine the motor speed during the defrost cycle.

FIELD OF THE INVENTION

The present invention pertains to the field of control systems and more specifically to a proportional control system for a ventilation system.

BACKGROUND

The present invention generally relates to an apparatus for ventilation systems which have means for the transfer of sensible heat and/or water moisture between exhaust air (taken from inside a building) and exterior fresh air (drawn into the building). Such an apparatus may, for example, have means for the transfer of sensible heat and/or water moisture from warm exhaust air to cooler exterior fresh air, the systems using warm interior air as defrost air for defrosting the systems during cool weather.

Sensible heat and/or water moisture recovery ventilation systems are known which function to draw fresh exterior air into a building and to exhaust stale interior air to the outside. The systems are provided with appropriate ducting, channels and the like which define a fresh air path and an exhaust air path whereby interior air of a building may be exchanged with exterior ambient air; during ventilation the air in one path is not normally allowed to mix with the air in the other path.

A sensible heat and/or water moisture recovery ventilator device or apparatus, which may form part of a ventilation system, in addition to being provided with corresponding air paths may also be provided with one or more exchanger elements or cores, e.g. one or more rotary and/or stationary (i.e. non-rotary) exchanger elements or cores. Heat recovery ventilation devices may also have a housing or cabinet; such enclosures may for example be of sheet metal construction (e.g. the top, bottom, side walls and any door, etc. may be made from panels of sheet metal). The heat exchanging core(s), as well as other elements of the device such as, for example, channels or ducts which define air paths, filtration means, insulation and if desired one or more fans for moving air through the fresh air and exhaust air paths may be disposed in the enclosure. Such ventilation devices may be disposed on the outside of or within a building such as a house, commercial building or the like; appropriate insulation may be provided around any duct work needed to connect the device to the fresh air source and the interior air of the building. A stationary heat exchanger element(s) may, for example, take the form of the (air-to-air) heat

exchanger element as shown in U.S. Pat. No. 5,002,118. Thus, the heat exchanger element(s) may have the form of a rectangular parallepiped and may define a pair of air paths which are disposed at right angles to each other; these exchanger element(s) may be disposed such that the air paths are diagonally oriented so that they are self draining (i.e. with respect to any condensed or unfrozen water).

During the winter season, the outside air is not only cool but it is also relatively dry. Accordingly, if cool dry outside air is brought into a building and the warm moist interior air of the building is merely exhausted to the outside, the air in the building may as a consequence become uncomfortably dry. A relatively comfortable level of humidity may be maintained in a building by inter alia exploiting an above mentioned desiccant type thermal wheel for transferring water from the stale outgoing air to the relatively dry fresh incoming air. During winter these types of heat exchangers may transfer up to 80% of the moisture contained in the exhaust air to the fresh supply air. Advantageously a rotary exchanger wheel may transfer both sensible and latent heat between fresh air and exhaust air; in this case the exhaust air stream as it is cooled may also be dried whereas the incoming fresh air may be warmed as well as humidified. However, a problem with such heat recovery ventilation equipment having a desiccant type heat exchanger wheel, is the production of frost or ice in the air permeable heat exchange matrix of the thermal wheel.

During especially cold weather such as -10.degree. C. or lower (e.g. -25.degree. C. or lower), prior to expelling the relatively warm exhaust air, the equipment provides for the transfer of latent heat from the relatively warm moist exhaust air to the relatively cool dry (fresh) outside air by the use of a suitable desiccant type heat exchange wheel. However, the cooling of the relatively moist interior air by the cold exterior air can result in the formation of ice (crystals). An uncontrolled buildup of ice within the matrix of a rotary exchanger wheel can result in decreased heat transfer, and even outright blockage not only of the exhaust air path but the (cold) fresh air path as well. Accordingly a means of periodically defrosting such a system is advantageous in order to maintain the system's efficiency.

A defrost mechanism has been suggested wherein the fresh air intake is periodically blocked off by a damper and warm interior air is injected, via a separate defrost air conduit, into the fresh air

inlet side of the fresh air path of the ventilation apparatus. However, during the defrost cycle, the stale inside air is still exhausted to the outside via the exhaust air path; this is disadvantageous since by blocking only the fresh air inlet and continuing to exhaust interior air to the outside, a negative air pressure can be built up in the interior of a building relative to the exterior atmosphere. Such a negative pressure may induce uncontrolled entry of air through any cracks and cranies in the structure of the building; the negative pressure may, in particular, produce a backdraft effect, for oil and gas type beating systems, whereby exterior air may be pulled into the chimney leading to the accumulation of gaseous combustion products in the building.

An alternate system has been suggested wherein both the fresh air inlet and exhaust air outlet are both blocked off such that warm interior air is circulated through the fresh air side of the heat exchanger element as well as through the exhaust air side of the heat exchanger element and is sent back into the building; see for example U.S. Pat. No. 5,193,610.

Another problem with respect to ventilation systems comprising a heat exchanger element or core relates to the installation of an exchanger device in a building such as for example a house or other type of building. In order for the system to operate efficiently and effectively the outgoing exhaust air flow preferably at least substantially equals the incoming fresh air flow; i.e. the exhaust and fresh air flows are preferably balanced so as to minimize or eliminate under-pressure or over-pressure in the house relative to the outside atmospheric pressure; a certain degree of overpressure may, however, be tolerated.

Presently, such ventilation systems are balanced by means of balancing dampers and removeable flowmeters such as, for example, a pitot tube type flow measuring device comprising a manometer to measure pressure difference; these elements must usually be installed by the balancing technician at appropriate places in the duct work connected to the ventilation device.

Given the above, it would be advantageous to have a control system in order to defrost a ventilation system which does not require the use of motors at full speed during the defrost operation or the addition of a number of additional components to the ventilation system. It

would also be advantageous to have a ventilation system with a defrost system that is controlled by the outside temperature and the speed of the motors.

It would also be advantageous to have a defrostable ventilation apparatus which is of simple construction.

This background information is provided for the purpose of making known information believed by the applicant to be of possible relevance to the present invention. No admission is necessarily intended, nor should be construed, that any of the preceding information constitutes prior art against the present invention.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a proportional control system for a motor. In accordance with an aspect of the present invention, there is provided a proportional control system for use in a ventilation system comprising a central processing unit, programmed with a air exchange – defrost cycle operatively connected to a temperature sensor located in the air intake area of an HVAC unit and one or more motors located in the stale air intake of an HVAC unit wherein the temperature sensors determine the motor speed for the defrost cycle.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 is a side perspective of one embodiment of the present invention.
Figure 2 is a side perspective of a heat exchanger.
Figure 3 is a perspective, broken away enlarged and partially schematic view of a portion of the heat exchanger shown in Figure 2.
Figure 4 is a side perspective of one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Definitions

The term "Sensing means" is used to define components capable of measuring various factors independent or dependent of a ventilation system. The sensing means are positioned in an area of the HVAC unit where exterior air enters the ventilation system. The sensing means measures one or more factors of the air and these measurements are then sent to a processing means.

The term "Processing means" is used to defined an electronic circuit which obtains measurement readings from the sensing means operatively associated with a ventilation system and subsequently evaluates the required power to be applied to the motors.

The term "Motors" is used to define a motor used to activate a blower or an impeller commonly found in a ventilation system. The motor is controlled by the processing means to evacuate stale air which is passed through a heat exchanger prior to being evacuated outside of a building.

The term "Contact Area" is used to defined an area where the presence of undesired materials is accumulated. The contact area is an area within a heat exchanger of a ventilation system. The undesired materials of the present invention is the presence of frost on a surface.

Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs.

The present invention provides a system that enables to control the speed of motors in relation to the measurement of factors independent of the motors. A processing means, sensing means and motors are operatively associated to a ventilation system. The sensing means monitor atmospheric factors such as the air temperature and relays such measurements to the processing means. The processing means through these measurement determines the appropriate motor speeds to potentially reduce the noise and wasted energy emitted from the use of the motors during the removal of frost accumulated on a contact area. The further variation of the motor speed may be determined through the sensing means measurement.

Sensing Means

In one embodiment of the present invention ,the sensing means may be defined as components able to measure the air temperature, atmospheric pressure, relative humidity or any other atmospheric factor known to a worked skilled in the art. The sensing means may also be define as components capable of measuring various characteristics dependent of a ventilation system such as the air flow, the air pressure or the temperature of any components within a ventilation system or any other characteristics of a ventilation system as would be known by a worker skilled in the relevant art. The components utilised to measure these characteristics may be defined as diodes, transistors, thermocouples, thermistors, semiconductors or any other appropriate measuring devices as would be known by a worker skilled in the art.

Processing Means

In one embodiment of the present invention, the processing means may provide sensor excitation and signal conditioning circuits for each sensor system, a digitizer, for converting analog sensor signals to digital values, a microcontroller, having non-volatile program memory, volatile working memory, and persistent memory for adaptive parameters. The processing means may also receive user input to control the operation and produce outputs including audible and visible alarms. The processing means may be battery powered, and is preferably intrinsically safe, meaning that, even with a fault condition, it will not be capable of igniting a combustible gas in the environment. This intrinsic safety is achieved by the avoidance of energy storage elements configured to provide spark energy to ignite a flame, and through the use of flame arresters.

In another embodiment, the processing means may store a program in read only memory (ROM). The processing means may operate by using temporary storage in registers and random access memory (RAM). Sensor calibration data, as well as environmental factors and data about the ventilation unit may be periodically stored and updated in electrically erasable programmable read only memory (EEPROM).

In one embodiment, the processing means has two states namely an active state and a defrost state. Both the active and defrost state are implemented by the processing means for a specific amount of time and at specific motor speeds respectively. These two states can be varied by the

processing means dependent on the environment in which the HVAC unit is installed. The active state can be prolonged or diminished as the defrost state can also be prolonged or diminished. The motor speeds can also be increased or diminished based on the environment in which the HVAC unit is installed.

Motors

In one embodiment, the motors are devices which provide the necessary mechanical power for the flow rate within a ventilation system such as an electrical motor or any other motor suitable for a ventilation system as would be known by a worker skilled in the relevant art.

Contact Area

In one embodiment of the present invention, the contact area may be defined as the an area within a heat exchanger located near the exhaust of a ventilation system. The materials used to manufacture heat exchangers may be composed of steel, metal, plastic, or any other material as would be known by a worker skilled in the art for the construction of heat exchangers. The contact area must also be of a rigidity wherein the accumulation of material such as frost will not shear or break the contact area.

In one embodiment of the present invention, the material used to manufacture the contact area or the heat exchanger of the ventilation system may be material with a relatively high conductivity of electricity in order to allow the use of a sensing means that measures the conductivity of a material when frost is accumulated on the contact area.

In one embodiment and with reference to Figure 1, a ventilation system encompasses a proportional control system for a motor. The fresh air intake **10** with an attached impeller **20** pushes air through a heat exchanger **30**. The heat exchanger **30** has a square shape and can be made of plastic. The heat exchanger **30** utilised in this embodiment will be further described below in greater detail. Once air passes through the heat exchanger **30**, the air is then circulated within the ventilation system through the air exhaust **40**. Stale air is removed from the ventilation system through the stale air intake **50** with an attached impeller **60**. The stale air is then passed

through the heat exchanger **30** and evacuated outside the building through the stale air exhaust **70**.

In one embodiment and with reference to Figure 2, a commonly used heat exchanger **30** for use in a ventilation system is shown. The heat exchanger **30** enables air to pass in the direction **80** or the direction **90**. The outside air enters the heat exchanger **30** in the direction **80** and the stale air enters the heat exchanger **30** in the direction **90**.

With further reference to Figure 3, the heat exchanger structure comprises a plurality of plastic extrusions **100** with closely spaced parallel passageways **104** separated by square extruded channel members **102** extending perpendicular to the direction of the passageways **104**. Although only two of the extrusions **100** and a pair of channel members are shown in Figure 3, for the sake of simplicity in the drawings, it should be understood that there are many extrusions and channel members in the typical heat-exchanger.

With further reference to Figure 3, each extrusion **100** comprises a solid top sheet **101** and a solid bottom sheet **103** with multiple vertical walls forming the passageways **104**. Thus, crossed air flow paths are formed by the passageways **104**, on the one hand, and the spaces **106** between the channel members and the hollow interiors of the members **102**. These crossed flow paths are isolated from one another by the solid sheets **101** and **103**.

The exhaust air preferably flows through the larger passageways **106**, as indicated by the arrow **107**, and the outside air flows through the passageways **104**. This arrangement is preferred because the exhaust air may have entrained water droplets and condensation and ice may form in the exhaust air passageways so that the larger passageways will remain operative for heat transfer over a wider range of operating circumstances than if the smaller passages were used. Although condensation also will occur when hot, humid outside air is cooled in the heat exchanger, it is believed that the larger passageways will better suit the conduct of exhaust air.

The material of which the heat exchanger **30** is made preferably is polyethylene or polypropylene, or other plastic materials which also are impervious to deterioration under prolonged contact with water and flowing air.

Equivalent heat exchangers also can be used in the practice of the invention. For example, isolating heat exchangers made of various metals can be used, as well as heat pipes whose ends are isolated from one another with one end in the outside air flow and the other in the exhaust air flow. Hydronic heat exchangers with liquid working fluids also can be used.

The plastic heat exchanger described above is advantageous over the usual metal heat exchanger, even though the heat conductivity of the plastic is considerably lower than that of the metal. The plastic lasts a very long time without corroding and is considerably less expensive than metal. Also, the plastic heat exchanger is less expensive to manufacture than metal heat exchangers. The added volume required for the plastic heat exchanger to exchange the same amount of heat as a metal heat exchanger is more than offset by the foregoing advantages.

The plastic heat exchanger is believed to be particularly advantageous when used with evaporative cooling because any scale which forms from the water spray can be broken free relatively easily by flexing the heat exchanger

In one embodiment of the present invention and with reference to Figure 4, specific cycle times are pre-set for the ventilation system. The ventilation system will be in the active mode for 20 minutes and the defrost cycle will then be activated for 5 minutes. The motor speeds of the stale air intake impeller **60** will be determined by the outside air temperature measured by the sensing means **120**. The measurement by the sensing means will be sent to the processing means **130**. The processing means **130** will then determine the speed of the stale air exhaust. For example, if the outside air temperature is -5° Celsius, the speed of the stale air intake impeller **50** will be activated at its lowest speed. The speed of the stale air intake impeller **50** will be increased proportionally based on the outside air temperature wherein the speed of the stale air intake impeller **50** will be at its maximum when the outside air temperature reaches or is lower than -25° Celsius. The maximum impeller speed will remain active during the defrost cycle until the

outside air temperature increases higher then -25° Celsius wherein the speed of the stale air intake impeller **50** will be proportionally diminished to a minimum speed only once the outside temperature reaches to -5° Celsius. For example, the speed of the stale air intake impeller will be at mid range when the sensing means measures an outside air temperature of –15° Celsius. If the outside air temperature reaches higher than -5° Celsius then the defrost cycle will not be initiated. The active cycle of the ventilation system will be activated otherwise the ventilation system operates for a active cycle of 20 minutes and then activates a defrost cycle for 5 minutes at variable motor speeds of the exhaust intake.

With further reference to Figure 4, the contact area **140** is generally located the area where defrost will be generated. During the defrost cycle, frost will melt creating water which may be evacuated from the HVAC unit **150** through a drain **160**.

The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A proportional control system for use in a ventilation system comprising:

A central processing unit, programmed with a air exchange – defrost cycle operatively connected to:

a) a temperature sensor located in the air intake area of an HVAC unit; and
b) one or more motors located in the stale air intake of an HVAC unit;

wherein the temperature sensors determine the motor speed during the defrost cycle.

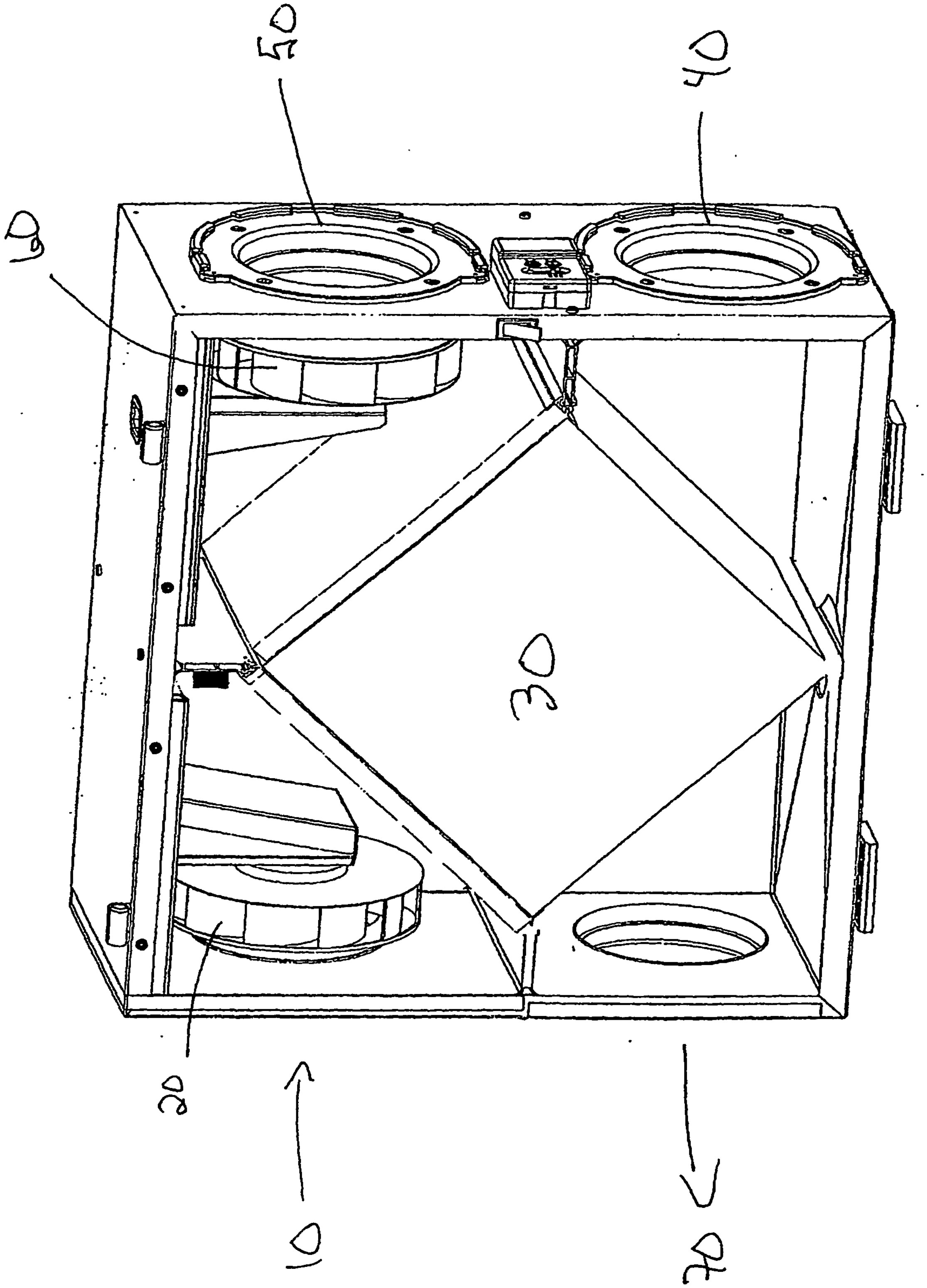

FIGURE 1

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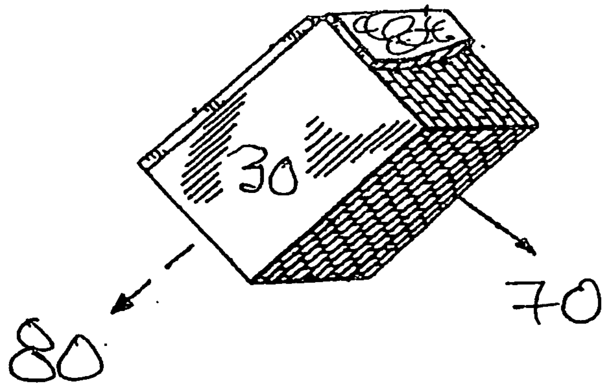

FIGURE 2

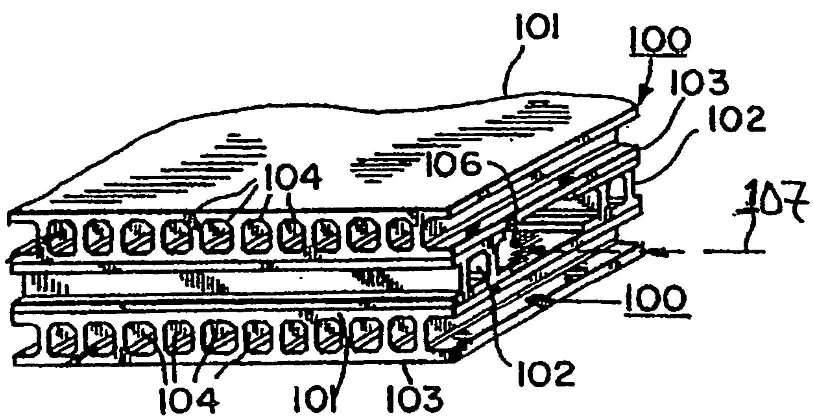

FIGURE 3

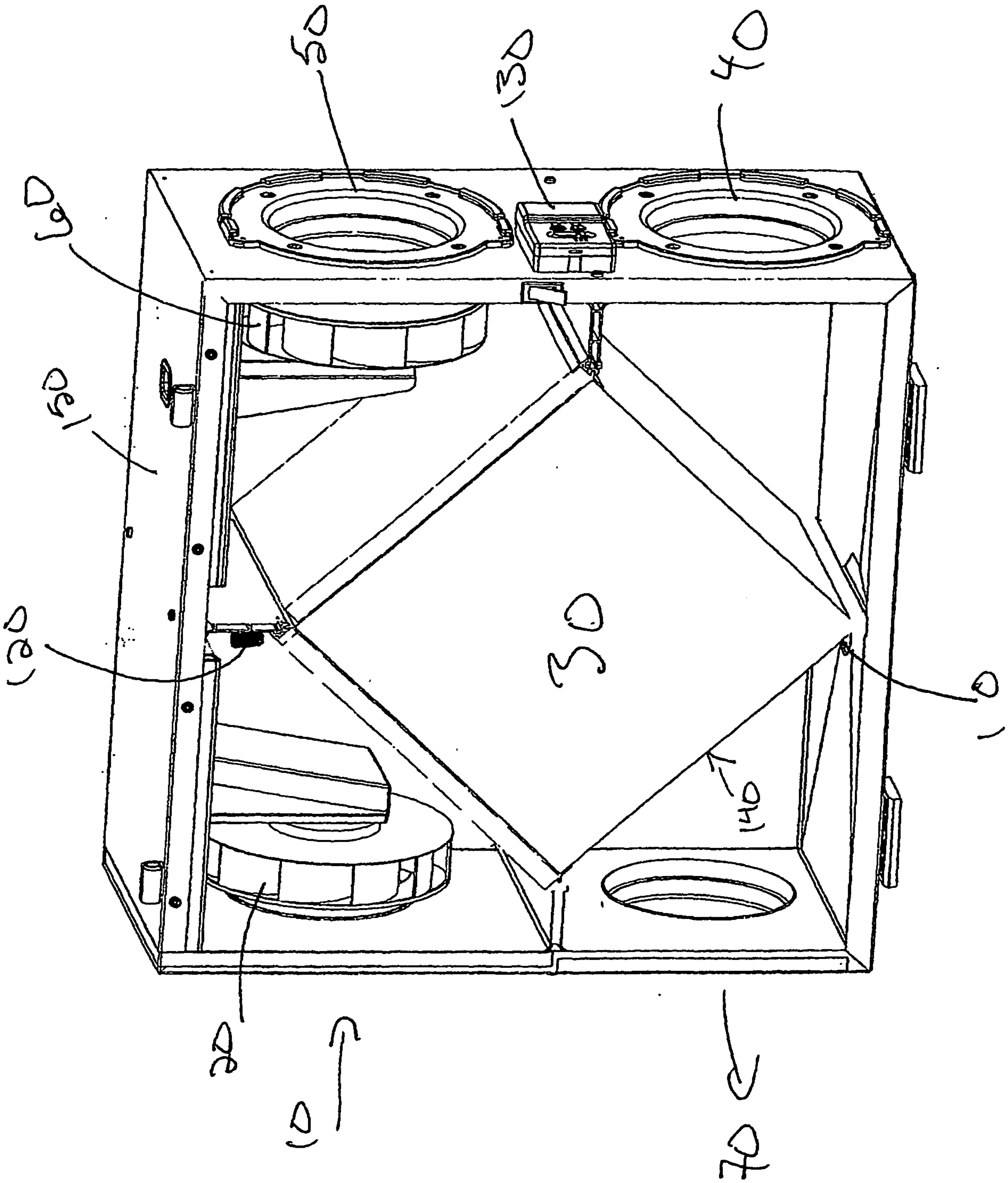

FIGURE 4

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